

sides of the river Bhavani was 'sparse' but there is no doubt that the species had been present in the recent past (Nicholson 1887, vol. II: 12).

The archival evidence on the killing of cheetah for bounties is backed by references in printed records such as district manuals, gazetteers and memoirs. But the former are far more detailed on the number of animals killed, the amount of rewards paid and the year in which bounties were given. What is crucial is that administrative policy played a major role in its extermination in British India. Much more work is required on the princely states to establish if this was, or was not, the case in these territories. But the level of the 'drain' on wild cheetah populations was substantially higher than has

been supposed. Further, the species often disappeared before its prey base declined or its habitat was taken over for cultivation. It is, of course, possible, that bounty-killing exacted a heavier toll because of a relative decline, if not extinction, of wild prey species like the blackbuck. But the tracks on the trail do point to a larger role for direct extermination as opposed to indirect causes for the decline and eventual extinction of the cheetah in India.

In all there are 9 more instances of cheetahs seen or shot.

January 12, 1998 MAHESH RANGARAJAN
Nehru Memorial Museum & Library,
New Delhi.

REFERENCES

- National Archives of India, New Delhi, India: Home (Public) Department. India Office Library and Records, London, UK: Agriculture and Forests (P 9912):
- ALLEN, G.O. (1920): Caracal (*Felis caracal*) and Hunting Leopard (*Cynaelurus jubatus*) in Mirzapur district, UP, *J. Bombay nat. Hist. Soc.* 26 (4): 1041.
- BURTON, R.G. (1920): The hunting leopard (*Cynaelurus jubatus*) *J. Bombay nat. Hist. Soc.* 27 (3): 397-8.
- DIVYABHANUSINH (1995): The End of a Trail, The cheetah in India, Banyan Books.
- GHORPADE, Y.R. (1955): Wildlife Preservation in India-Annual Report for 1953, Southern Region, *J. Bombay nat. Hist. Soc.* 53 (1): 103-109.
- HEWETT, J.P. (1938): Jungle trails in Northern India, Reminiscences of hunting in India, Methuen, London.
- KING MARTIN, D. (1988): Ways of Man and Beast in India, Wright and Brown, London.
- MANAKADAN, R. (1988): Shikaris of Nandikotkur, *Hornbill*, v. 2, 18-20.
- MORRIS, R.C. (1936): Further Records of the distribution of the cheetah (*Acinonyx jubatus* Exl.) in Southern India, *J. Bombay nat. Hist. Soc.* 38 (3): 610.
- LE GRAND JACOB (1843): Report upon the general condition of the province of Kateewar in 1842, Bombay.
- LOWRIE, A.D. (1910): Central Provinces, District Gazetteers (CPs DGs), Drug district, Volume A, Descriptive, Calcutta, BMS Press.
- NELSON, A.E. (1909): CPs, DGs, Raipur district, Volume A, Descriptive, Byculla Press, Bombay.
- NELSON, A.E. (1910): CPs DGs, Buldana District, Volume A, Description, BM Press, Calcutta.
- NICHOLSON, F.A. (1887): Ed. by Rev. H A Stuart, Madras District Manuals, Coimbatore, Madras, Volume II.

4. ANTI-PREDATORY RESPONSE OF THE INDIAN GIANT SQUIRREL *RATUFA INDICA* TO PREDATION ATTEMPTS BY THE CRESTED HAWK EAGLE *SPIZAETUS CIRRHATUS LIMNAETUS*

Since most mammalian carnivores are nocturnal, birds of prey are likely to be the most important predators of diurnally active squirrels (Emmons 1980, Hall 1981). Most studies on temperate and tropical squirrel species have

documented the importance of diurnally active raptors as predators over mammalian ones (Emmons 1980, Hall 1981, Borges 1993, Joshua 1992).

Ramachandran (1991), Joshua (1992),

Joshua and Johnsingh (1994) and Borges (1993) observed predation attempts by the black eagle (*Ictinaetus malayensis perniger*) and crested serpent eagle (*Spilornis cheela*) on the Indian giant squirrel and grizzled giant squirrel (*Ratufa macroura*).

I observed three unsuccessful predation attempts by the crested hawk-eagle (or changeable hawk-eagle) (*Spizaetus cirrhatus limnaetus*) on the Indian giant squirrel (*Ratufa indica*) during field work for a study on the Indian giant squirrel in Bori Wildlife Sanctuary (WLS), area (486 km²) which lies in the Satpura hill ranges, (22° 19' to 22°30' N and 77° 56' to 78° 20' E), Madhya Pradesh. Though the crested serpent eagle was also seen frequently in the study area and elicited alarm calls from squirrels, I did not see any predation attempts by this species. Both the raptor species were usually sighted in the riparian area at mid-morning and frequently in the afternoons.

The major forest types in Bori WLS are dry to moist teak (*Tectona grandis*) forests and mixed forests (Champion and Seth 1968).

The study was conducted in two riverine patches surrounded by deciduous forests. One of these, along Bhainsa nala, suffered disturbance due to the presence of two villages, cattle grazing, a teak nursery and buildings of the Forest Corporation set up in 1975. Gaps exist in the forest canopy due to the felling of trees in the past. The other study site was a relatively undisturbed riparian habitat along Churnagundi nala, which flows into Bhainsa nala. Though cattle were seen here, the study area was largely free from human disturbance.

Five individually identified squirrels were observed from dawn to dusk using focal animal sampling (Altmann 1974). Focal animals were followed twice a month during the study period from December 1992 to April 1993. Two other individuals were also observed for 2 days each in December.

All predation attempts were observed in Bhainsa nala. In March, out of 6 observation

days, raptors were sighted on 4 days. Two predation attempts were recorded at mid-morning, while one was observed in the afternoon.

One of the attempts occurred around 1000 hrs while observing a squirrel feeding on *Terminalia arjuna* fruits. Two other squirrels were feeding on the same tree. On a nearby *Bombax ceiba*, two more individuals were feeding on the red flowers. A crested hawk-eagle *Spizaetus cirrhatus limnaetus* flew in and perched on the tree. It did not seem to be hunting actively. Two squirrels immediately mobbed it, approaching close and giving loud alarm calls repeatedly. The hawk-eagle responded with wings outstretched, but seemed unperturbed and did not attempt to catch them. After a while, one of the squirrels left the *B. ceiba* tree and was moving along the branches of a *Terminalia tomentosa* tree when the eagle swooped down in an attempt to catch it. The squirrels, instead of fleeing, immediately turned and faced the predator with alarm calls. In the meantime, the other squirrel on the *Bombax ceiba* tree had also moved onto this tree and mobbed the predator. The three other squirrels on the adjacent *T. arjuna* tree also started calling in alarm. The hawk-eagle made a half-hearted attempt to catch one of the squirrels and then flew away through the canopy.

The second predation attempt was observed one afternoon in March while following a focal animal, which was resting inside its nest. At 1411 hrs, I observed another focal squirrel (a sub-adult male) on a *T. arjuna* tree across the nala. It had come out of its nest and was resting on a broad shady branch. A crested hawk-eagle flew in and made an unsuccessful attempt to catch it. The squirrel reacted with loud repeated alarm calls and 'mobbing' the hawk-eagle, approaching as close as 1-2 m. The crested hawk-eagle spread its wings six times in response to the mobbing and made another attempt to catch it with wings outspread. The squirrel called, moved down 3 m, but again approached the hawk-eagle. The

crested hawk-eagle watched the squirrel, but appeared disinterested and even started preening its wing feathers. The squirrel kept the predator in sight and then at 1426 hrs it retreated to a lower branch 6-7 m away, continually giving alarm calls. At around 1428 hrs the squirrel was not visible anymore, since it had moved behind the trunk of the *Terminalia arjuna* tree. The crested hawk-eagle was still perched on the tree. At around 1437 hrs, another squirrel was seen moving onto the tree, but it did not notice the predator till it was very close. The hawk-eagle spread its wings and flew away. This squirrel gave alarm calls and then rested on the same branch.

I observed a third predation attempt by an immature crested hawk-eagle on the sub-adult male squirrel in the morning. The squirrel immediately emitted loud alarm calls, faced the eagle and approached it close instead of trying to hide or escape. The hawk-eagle seemed to have given up. It perched on a *T. arjuna* branch and started preening its wing feathers (displacement behaviour?). when the squirrel approached too close, it responded with outstretched wings but did not attempt to catch it.

On all these occasions, a prolonged predator-prey interaction was observed — the squirrel which was attacked responded by 'mobbing' the predator. In a manner which seemed suicidal, they approached the predator close (within 1 m) and gave repeated loud staccato calls in full view of the predator. This behaviour was seen only when a predator made an attack, or when the squirrel was sure that the predator had seen it. But on occasions when raptors flew overhead, squirrels refrained from giving any alarm call and remained quiet, either becoming alert or flattening their bodies against a branch. Squirrels gave loud alarm calls mostly on occasions when the predator came very close. This behaviour seems to lend anecdotal evidence for Zahavi's hypothesis that the function of the alarm call is not to warn conspecifics, neighbours

or kin, but as a signal to the predator that it had been noticed. This is supported by the fact that during the 3 different predation attempts observed, the raptor seemed to be startled by the prey's response and did not attempt to catch the prey after the repeated mobbing. In social animals, it is likely that the function of the alarm call is to warn conspecifics or kin, but in a solitary territorial species like the giant squirrel this may be unlikely.

It is also possible that the predator was an immature eagle, and therefore the squirrels approached close and 'mobbed' it, or that it was not hunting actively. Emmons (1980) reports that African squirrels mob inactive predators. She has defined "mobbing" as an event where one or more squirrels of the same or different species give alarm calls and display in the neighbourhood of predators. Hall (1981) also describes incidents of unsuccessful predation attempts by immature red-tailed hawks where the squirrels did not seem to be frightened, and gave repeated alarm calls even when the predator was perched just 3 m above them.

The crested hawk-eagle has not been reported earlier as a predator of giant squirrels. In addition, this is the first reported instance of 'mobbing' of a predator by giant squirrels.

ACKNOWLEDGEMENTS

I thank the Madhya Pradesh Forest Department for permission to work and Mr. M. Chacko, ACF, Bori WLS for help during the study. I thank Mr. Chet Ram for assistance in data collection and Manoj V. Nair for his comments on the draft.

September 10, 1997

APARAJITA DATTA
c/o Dr. G.S. Rawat,
Wildlife Institute of India,
Post bag # 18,
Chandrabani,
Dehradun-248 001

REFERENCES

- ALTMANN, J. (1974): Observational study of behaviour: sampling methods *Behaviour* 49: 227-266.
- BORGES, R.M. (1993): Resource heterogeneity and the foraging ecology of the Malabar Giant Squirrel (*Ratufa indica*). Ph.D. dissertation, University of Miami, Florida.
- CHAMPION, H.G. & S.K. SETH (1968): A revised survey of the forest types of India. Govt. of India Publications, New Delhi.
- DATTA, A. (1993): Space-use patterns of the Indian giant squirrel (*Ratufa indica centralis*) in relation to food availability in Bori Wildlife Sanctuary, Madhya Pradesh, India. Unpubl. M.Sc. thesis, Saurashtra University, Rajkot, Gujarat.
- EMMONS, L.H. (1980): Ecology and resource partitioning among nine species of African rain forest squirrels. *Ecological Monogr.* 50(1): 31-54.
- HALL, J.G. (1981): A field study of the Kaibab squirrel in the Grand Canyon National Park. *Wildlife Monogr.* 75: 1-54.
- JOSHUA, J. (1992): Ecology of the endangered grizzled giant squirrel (*Ratufa macroura*) in Tamil Nadu, South India. Ph.D. dissertation, Bharatidasan University, Tiruchirapalli, Tamil Nadu.
- JOSHUA, J. & A.J.T. JOHNSINGH (1994): Impact of biotic disturbances on the habitat and population of the endangered grizzled giant squirrel (*Ratufa macroura*) in south India. *Biol. Cons.* 68(1): 29-34.
- RAMACHANDRAN, K.K. (1991): Ecology and Behaviour of Malabar Giant Squirrel (*Ratufa indica maxima*) Schreber. K.F.R.I. Research Report: 55 (Summary).

5. A RECORD NUMBER OF BLACKNECKED GREBE *PODICEPS NIGRICOLLIS* FROM GUJARAT

We visited Okha (22° 15' N, 69° 01' E) in Jamnagar dist., Gujarat on December 28, 1996. On getting information of blacknecked grebe *Podiceps nigricollis* at the nearby Charakla salt farm (40 km. east of Okha), we reached there at 1720 hrs. We observed two salt water ponds measuring 2 sq. km and about 2 m deep, where the grebes had concentrated. Two neighbouring ponds of similar dimensions did not have any grebe. Since the grebes dive frequently and come to the surface at a short distance, we found it a little difficult to make an accurate count. A total count of 201 blacknecked grebe is a minimum estimated number but we believe the actual number to be a little higher. The other birds worth noting in the same area are as follows:

Flamingo	<i>Phoenicopterus roseus</i>	494
Lesser Flamingo	<i>Phoeniconaias minor</i>	315
Slenderbilled Gull	<i>Larus geni</i>	129

We also recorded 9 blacknecked grebe in a bird sanctuary at Porbander (21° 37' N, 69° 49'

E) on December 31, 1996. 3 grebes previously sighted at the same site on April 1, 1996 indicate that they might be regular visitors to the area.

One of us (BMP) has also recorded the species in central Gujarat — one bird at Nalsarovar, 25.i.1996; one bird on Vadadhla irrigation tank in Vadodara dist. 17.i.1993; and one bird on Kanewal reservoir, in Kheda dist., 12.i.1988.

Though the blacknecked grebe is recorded breeding in Baluchistan, it is an uncommon winter visitor to Nepal, Uttar Pradesh, Punjab, Gujarat and Maharashtra (Ali and Ripley 1983). In Gujarat, the species has been recorded from sewage canals in Bhavnagar (Dharmakumarsinhji 1952) and salt pans of Jamnagar dist. (Naik *et al.* 1991). Ali (1945, 1954) had not recorded this species during his survey of the birds of Kutch and Gujarat. However, since 1987, a few birds are being reported from Gujarat every year during the Midwinter Waterfowl Census. Our present record of its number and distribution supports Ali and Ripley's (1983) presumption that the species